WATER RESOURCES REVIEW for NOVEMBER 1973

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

CANADA
DEPARTMENT OF THE ENVIRONMENT
WATER RESOURCES BRANCH

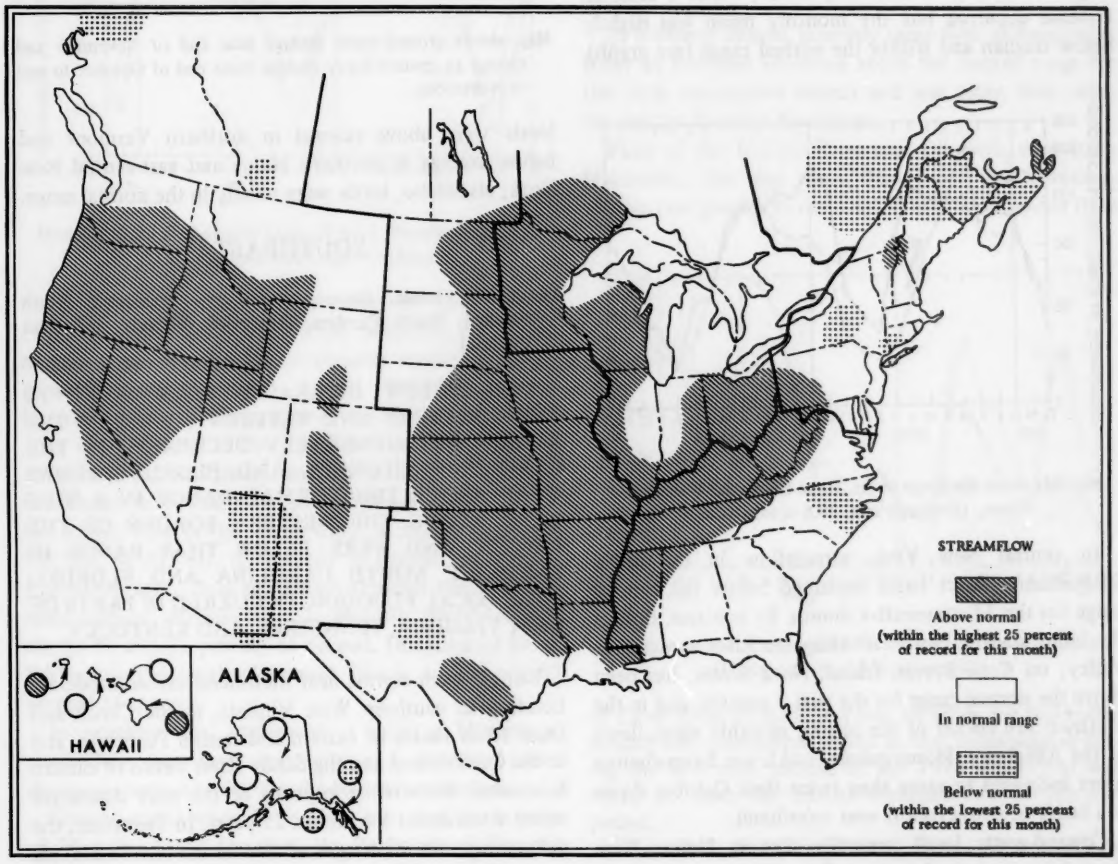
STREAMFLOW AND GROUND-WATER CONDITIONS

Streamflow increased in most of the United States other than Alaska and the Midcontinent region, and increased also in the Atlantic Provinces of Canada. Flows decreased elsewhere in southern Canada, and in Utah and the coastal southeastern States.

Monthly mean flows remained above the normal range in a large part of central United States, including much of the Mississippi and Ohio River basins. Monthly mean flow of Mississippi River at Vicksburg, Mississippi, has been in the above-normal range during fifteen of the past sixteen months. A second large area of above-normal flows developed in the eight-State area of the northwest.

Flows were below the normal range in parts of western and southeastern Canada, and in several basins in eastern and southwestern United States and southern Alaska.

Moderate to severe local flooding occurred in parts of Arkansas, Oklahoma, Missouri, West Virginia, Tennessee, and Kentucky.

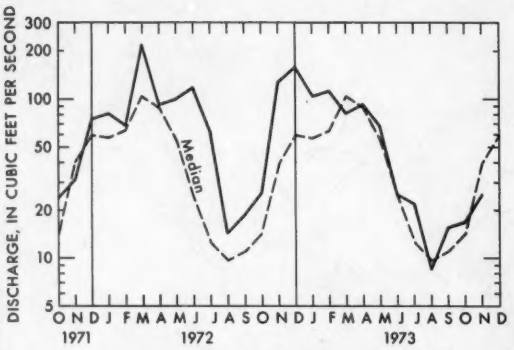


NORTHEAST

[Atlantic Provinces and Quebec; Delaware, Maryland, New York, New Jersey, Pennsylvania, and the New England States]

STREAMFLOW GENERALLY INCREASED SEASONALLY EXCEPT IN SOUTHERN QUEBEC, NORTHERN MAINE, AND WESTERN MARYLAND, WHERE FLOWS DECREASED AND WERE IN OR BELOW THE NORMAL RANGE. FLOWS REMAINED ABOVE THE NORMAL RANGE ON CAPE BRETON ISLAND, AND BELOW THAT RANGE IN SOME CENTRAL AND NORTHERN BASINS ELSEWHERE IN THE REGION.

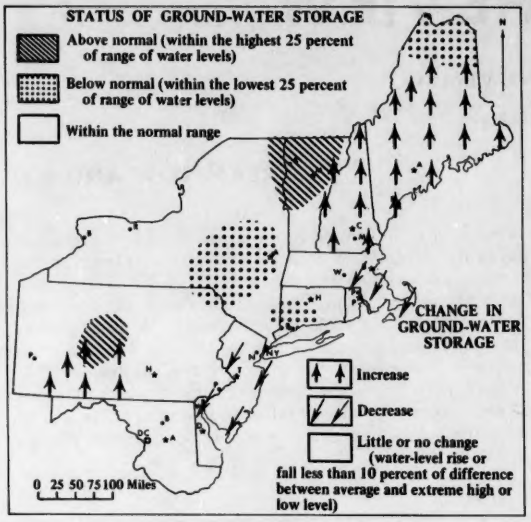
Streamflow followed the usual seasonal pattern of increasing flows in most parts of the region, but low carryover flows from October and below-average rainfall during November, caused flows in parts of New Brunswick, Nova Scotia, Maine, and New York, to remain in, or decrease into, the below-normal range. Typical of streamflow at many index stations was that of Mount Hope River near Warrenville, Conn., where a seasonal increase occurred but the monthly mean was slightly below median and within the normal range (see graph).



Monthly mean discharge of Mt. Hope River near Warrenville, Conn. (Drainage area, 28.6 square miles.)

In central New York, streamflow in the upper Susquehanna River basin remained below the normal range for the 3d consecutive month. By contrast, flow at the index station, Northeast Margaree River at Margaree Valley, on Cape Breton Island, Nova Scotia, has been above the normal range for the past 7 months, and in the southwestern corner of the region, monthly mean flows of the Allegheny, Monongahela, and lower Susquehanna rivers increased to more than twice their October flows as a result of storm runoff near monthend.

Ground-water levels generally rose in Maine, New Hampshire, and southwestern Pennsylvania; and fell in southeastern Massachusetts and southern New Jersey (see map). Elsewhere, the pattern of rising and falling levels varied considerably from place to place. Monthend



Map shows ground-water storage near end of November and change in ground-water storage from end of October to end of November.

levels were above normal in northern Vermont and below average in northern Maine and east-central New York; elsewhere, levels were mostly in the normal range.

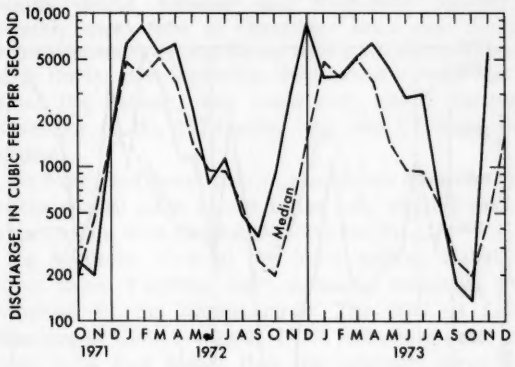
SOUTHEAST

[Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia]

STREAMFLOW INCREASED SEASONALLY IN THE NORTHERN AND WESTERN STATES OF THE REGION BUT GENERALLY DECREASED IN THE CAROLINAS, GEORGIA, AND FLORIDA. FLOWS WERE ABOVE THE NORMAL RANGE IN A WIDE BAND ALONG THE WESTERN BORDER OF THE REGION, AND WERE BELOW THAT RANGE IN PARTS OF NORTH CAROLINA AND FLORIDA. SOME LOCAL FLOODING OCCURRED IN PARTS OF WEST VIRGINIA, TENNESSEE, AND KENTUCKY.

Runoff from storms near monthend caused moderate flooding in southern West Virginia, in the Clinch and Duck River basins of eastern and central Tennessee, and in the Cumberland and Big Sandy River basins of eastern Kentucky. Recurrence intervals of the peak discharges varied from about 5 to about 25 years. In Tennessee, the daily maximum discharges of 19,900 cfs and 46,600 cfs on November 28 and 29, respectively, at the index stations on Harpeth River near Kingston Springs

(drainage area, 687 square miles), and Duck River above Hurricane Mills (drainage area, 2,557 square miles), were highest for November in records that began in July 1925 at both sites. In Kentucky, the daily maximum of 35,500 cfs on the 29th was the largest for November in 48 years of record at the index station, Licking River at Catawba (drainage area, 3,300 square miles). Monthly mean flows were above the normal range at all index stations in those three States and varied from about 2 to about 12 times the November medians. The sharp increase in flow that occurred on many streams in Kentucky and Tennessee during November is illustrated by the records for Green River at Munfordville, Ky. (see graph).



Monthly mean discharge of Green River at Munfordville, Ky. (Drainage area, 1,673 square miles.)

In North Carolina, streamflow in the eastern Piedmont and the Coastal Plain remained below the normal range for the 2d consecutive month. Monthly mean flow at the index station, Neuse River near Clayton, was only 23 percent of the November median.

In Florida, flow at the index station, Peace River at Arcadia, in the southwest, was less than half the November median flow, and in the below-normal range. Also, in the south, flow in the Miami Canal at Miami decreased 182 cfs, to 201 cfs; 68 percent of normal, and in the Everglades area, flow southward through the Tamiami canal outlets, 40-mile bend to Monroe, decreased 306 cfs, to 46 cfs; 21 percent of normal. Discharge of Silver Springs, in the north, decreased 20 cfs, to 760 cfs; 89 percent of normal.

In northern and southwestern parts of Mississippi, streamflow increased seasonally and monthly mean discharges were 4 to 5 times the November medians.

Ground-water levels declined, at least slightly, in most of Virginia, North Carolina, the Piedmont of Georgia, and in northern Florida (except in Broward County, where levels rose). Levels rose in most parts of Alabama and West Virginia. Levels rose also in the heavily pumped Savannah, Georgia, area. Monthend levels remained slightly above average in most of North Carolina and were above average also in West Virginia except for below-average levels along the southeastern border of the State. In southeastern Florida, monthend levels were near average except in south Dade County where they were as much as 1.5 feet below average.

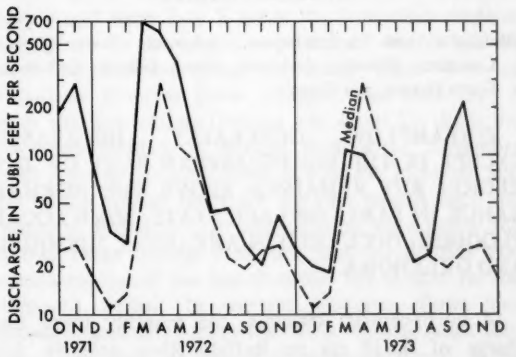
WESTERN GREAT LAKES REGION

[Ontario; Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin]

STREAMFLOW INCREASED SEASONALLY IN ALL PARTS OF THE REGION EXCEPT IN ILLINOIS, SOUTHERN MINNESOTA, AND SOUTH-CENTRAL ONTARIO. FLOWS REMAINED IN THE ABOVE-NORMAL RANGE IN OHIO AND MINNESOTA, AND IN SOME PARTS OF WISCONSIN AND ILLINOIS, AND INCREASED INTO THAT RANGE IN SOUTH-EASTERN ONTARIO.

In northern Illinois, monthly mean flow of Pecatonica River at Freeport remained above the normal range for the 16th consecutive month and was more than twice the median flow for November.

Flow of the Buffalo River near Dilworth, in western Minnesota, also was more than twice the November median (see graph). In east-central Minnesota, mean flow



Monthly mean discharge of Buffalo River near Dilworth, Minn. (Drainage area, 1,040 square miles.)

of Crow River at Rockford was 14 times the November median and cumulative runoff at that index station during the first two months of the 1974 water year was nearly 15 times the median cumulative runoff for that period.

In south-central Ohio, flow of Scioto River at Higby (drainage area, 5,131 square miles) increased sharply and the monthly mean discharge of 6,377 cfs, and the daily

mean of 32,500 cfs on the 29th, were highest for November since records began in 1931.

Streamflow in east-central Indiana also increased sharply near monthend. At the index station on Mississinewa River at Marion the monthly mean discharge was above the normal range and more than 4 times the monthly median.

In Michigan, streamflow increased in all parts of the State, but remained in the normal range for the 5th consecutive month.

Flows in Wisconsin and southwestern Onatrio generally increased and were in or slightly above the normal range. In northeastern and southwestern Wisconsin, monthly mean flows in Oconto and Pecatonica River basins have been in the above-normal range for the past 11 and 16 months, respectively. Flow of English River, in southwestern Ontario, increased and was above the normal range for the first month since September 1970.

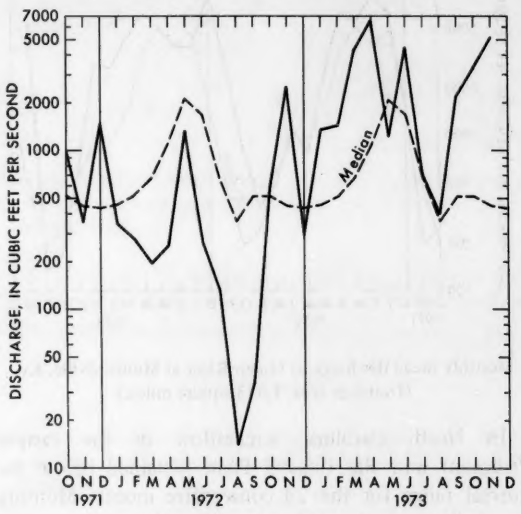
Ground-water levels declined in shallow water-table wells in Minnesota, Wisconsin, and Michigan's Upper Peninsula; and rose in Ohio, Indiana, and much of Michigan's Lower Peninsula. Monthend levels were again above average in Michigan, Wisconsin, and northern Minnesota, and were above average also in Ohio. Monthend levels were below average for the first time since May 1972 in Indiana and were below average also in southern Minnesota. In the Minneapolis-St. Paul, Minn., area, levels in wells tapping artesian aquifers continued to rise but remained below average.

MIDCONTINENT

[Manitoba and Saskatchewan; Arkansas, Iowa, Kansas, Louisiana, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, and Texas]

STREAMFLOW GENERALLY DECREASED EXCEPT IN THE SOUTHEASTERN PART OF THE REGION BUT REMAINED ABOVE THE NORMAL RANGE IN PARTS OF EACH STATE. SOME LOCAL FLOODING OCCURRED IN ARKANSAS, MISSOURI, AND OKLAHOMA.

In north-central Arkansas, the monthly mean discharge of 4,638 cfs on Buffalo River near St. Joe (drainage area, 825 square miles), the daily mean of 70,800 cfs, and the flood-peak discharge of 110,000 cfs, both on the 25th, were the highest for November in records that began in October 1939. In the south-central part of the State, flow increased at the index station, Saline River near Rye, was about 7 times the November median, and was above the normal range for the 4th consecutive month. Cumulative runoff at the Buffalo and Saline River stations for the first two months of 1974 water year was about 13 and 5 times the respective medians for that period. Local flooding occurred also on some tributaries of the Missouri and Mississippi Rivers in Missouri November 21–30. Monthly mean flow of Gasconade River at Jerome, in southern Missouri, increased seasonally and was more than 6 times the median for November. In northeastern Oklahoma, flooding occurred along Spavinaw Creek, November 24. The peak discharge of about 30,000 cfs at the gaging station near Sycamore (drainage area, 133 square miles) was twice the previous maximum in record that began in 1961. In southwestern Oklahoma, monthly mean discharge of Washita River near Durwood increased sharply, was about 12 times the November median, and was second highest for the month since records began in August 1928 (see graph).



Monthly mean discharge of Washita River near Durwood, Okla. (Drainage area, 609 square miles.)

In Louisiana, streamflow remained in the above-normal range at the index stations in the southeastern and northern parts of the State. Monthly mean flow of Red River was more than twice the long-term average for November, and flow of Atchafalaya River, which includes that of Red River plus diversion from the Mississippi River through the Old River diversion structure, equalled the maximum November mean discharge for the period of record beginning in 1935. Flow of Mississippi River downstream from the Old River diversion structure was about 1½ times the long-term average for November.

Streamflow in Iowa, Kansas, and Nebraska, generally remained in the above-normal range as a result of high carryover flows from October, augmented by November

rains. Monthly mean discharge of Saline River near Russell (drainage area, 1,502 square miles), in west-central Kansas, was nearly 8 times the November median, and the daily mean of 879 cfs on the 20th was highest for November in 22 years of record. In northeastern Nebraska, mean flow of Elkhorn River at Waterloo (drainage area, 6,900 square miles) was double the November median, and the daily mean flow of 2,290 cfs on the 22d was highest for the month since records began in September 1928. In Iowa, streamflow increased near monthend and monthly mean discharge at representative streamflow stations across the State varied from 3 to 8 times their respective November medians.

In eastern Texas, flow of Neches River near Rockland increased seasonally, remained above the normal range for the 8th consecutive month, and was about 14 times the November median. Cumulative runoff for the 1974 water year has been 16 times the median for the two-month period, October and November. Similarly, monthly mean flow of Guadalupe River near Spring Branch, in south-central Texas, was in the above-normal range for the past 5 months, the November mean was 8 times the median, and cumulative runoff through November of the 1974 water year was 13 times the median.

In North and South Dakota, streamflow generally was in the normal range except in the east, where flows of some streams were above the normal range.

In Manitoba, flow at the index station, Waterhen River below Waterhen Lake, decreased seasonally and remained in the normal range. The level of Lake Winnipeg at Gimli averaged 714.06 feet above mean sea level, 0.74 foot higher than the long-term mean for November and 0.20 foot higher than last month.

Ground-water levels fell in Iowa and declined slightly in Nebraska (except for slight rises in the northwest) and North Dakota. Monthend levels remained above average in Iowa; were above average also in Nebraska, except in some heavily pumped areas; and were slightly below average in North Dakota. In the rice-growing Grand Prairie area of east-central Arkansas, levels rose both in the shallow aquifer (Quaternary deposits) and in the deep aquifer (Sparta Sand). In Louisiana, levels rose in several artesian aquifers and changed only slightly in the terrace deposits in the northwestern part of the State. In Texas, levels rose in the Edwards Limestone at Austin and in the bolson deposits at El Paso; and declined in the Edwards Limestone at San Antonio and in the Evangeline aquifer at Houston. Monthend levels were above average at Austin (alltime high in the 30-year period of record) and San Antonio; and lowest of record for November at Houston and El Paso.

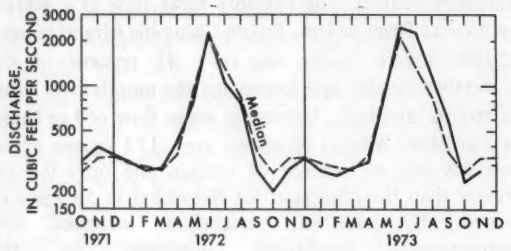
WEST

[Alberta and British Columbia; Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming]

STREAMFLOW GENERALLY INCREASED IN ALL PARTS OF THE REGION BUT DECREASED IN UTAH AND IN SOME BASINS IN COLORADO, NEW MEXICO, WYOMING, MONTANA, AND THE PROVINCES OF BRITISH COLUMBIA AND ALBERTA. ABOVE-NORMAL FLOWS OCCURRED IN A LARGE AREA CENTERED ON SOUTHEASTERN OREGON, AND COVERING ALL OR PARTS OF EIGHT NORTHWESTERN STATES. SMALLER AREAS OF ABOVE-NORMAL FLOW OCCURRED IN PARTS OF NEW MEXICO, COLORADO, AND WYOMING, AND BELOW-NORMAL FLOWS PERSISTED IN EASTERN ARIZONA, WESTERN NEW MEXICO, NORTHERN BRITISH COLUMBIA, AND SOUTHERN ALBERTA.

With the exception of the Skeena River basin in northern British Columbia, and Lee Creek basin in southern Alberta, streamflow in the northern part of the region increased into the normal, or above-normal, range during November. The monthly mean flow of 7,400 cfs on Skeena River at Usk, British Columbia (drainage area, 15,000 square miles) was only 41 percent of the November median and lowest for the month in 41 years of record. Similarly, November mean flow of Lee Creek at Cardston, Alberta (drainage area, 117 square miles) was 5.8 cfs, 45 percent of median and only 0.4 cfs greater than the minimum for November in 58 years of record. By contrast, streamflow increased and water-supply conditions improved in the drought-affected northwestern States. For example, monthly mean flows at the index stations, John Day River at Service Creek, Umpqua River near Elkton, and Wilson River near Tillamook, in Oregon, increased sharply and were 2 to 5 times the November medians and highest for the month in periods of 45, 68, and 44 years, respectively. Also, November mean flow of Willamette River at Salem, Oregon, was more than 4 times the flow during October and about 2½ times the November median. In eastern Washington, November mean flow of Spokane River at Spokane increased and was in the normal range for the first month since last February. Flows at that index station were below the normal range during 9 of the past 10 months and cumulative runoff was less than half the median for the 10-month period. In western Montana, flows also increased generally, from the below-normal range into the normal range, as a result of snowmelt runoff. In the southern part of that State, flow of Yellowstone River at Billings was slightly lower than during October but was in the above-normal range for November. In north-central Idaho, the daily mean discharge of 18,100 cfs on the 13th at the index station, Salmon River at White Bird (drainage area, 13,550 square miles) was highest for November in 61 years of record, and the monthly mean of 7,812 cfs was exceeded only once in November during that period. Similarly, November flow of Weiser River near Weiser was highest for the month in 57 years of record.

In northern Utah, streamflow remained above the normal range, but elsewhere in the State, flows were near the median. Also in the north, the level of Great Salt Lake rose 0.05 foot (to 4,199.40 feet above mean sea level), 0.95 foot higher than a year ago and 8.05 feet above the alltime low of October 1963. In northern New Mexico, and the adjacent area of Colorado, flow of Rio Grande remained above the normal range, and in southwestern New Mexico and the adjacent area of Arizona, flow of Gila River remained below the normal range. Elsewhere in Arizona, November flow of San Pedro River at Charleston, in the southeast, remained below the normal range and Little Colorado River near Cameron, in the northeast, remained dry for the 2d consecutive month. In central Colorado, flow at the east-slope index station, Arkansas River at Canon City, increased seasonally but remained below median for the 2d consecutive month (see graph).



Monthly mean discharge of Arkansas River at Canon City, Colo. (Drainage area, 3,117 square miles.)

In northwestern California, monthly mean flow of Smith River near Crescent City was more than 5 times the November median, highest for the month in 42 years of record, and nearly double the previous maximum November mean. Also in the north, flow of North Fork American River at North Fork Dam, representing runoff from the northern part of the Sierra Nevada, increased sharply (to about 20 times the flow during October), and was 11 times the November median. Cumulative runoff at this index station during the first two months of the 1974 water year was nearly 8 times the median for the 2-month period. The inflow to Shasta Lake, on Sacramento River, was 1,417,000 acre-feet during November, the largest for the month since the reservoir was completed in 1942.

Reservoir storage at monthend was below average in Idaho, near average in Washington, and above average in Arizona, California, Nevada, and Colorado. Contents of the Colorado River Storage Project decreased 105,200 acre-feet during the month.

Ground-water levels generally rose in the lowlands of western Washington, in Utah (except in the southeast), and in southern New Mexico; rose or remained about the same in southern Arizona; and declined in Nevada, Montana, the Spokane area of eastern Washington, and the Boise Valley (sand and gravel aquifer) of southern Idaho. Monthend levels were near or above average in Nevada (except in the heavily pumped Truckee Meadows and Las Vegas areas), in southern California, and in the Snake Plain aquifer near Atomic City in southern Idaho; and were below average in Utah (except in the southeast), southern New Mexico, western Washington and the Spokane area, and in Montana.

ALASKA

Streamflow decreased seasonally at all index stations in the State, was below the normal range on Gold Creek near Juneau, in the southeast, and on Kenai River near Cooper Landing and on Tanana River at Nenana, in the south-central and central parts of the State, respectively. The monthly mean discharge of 876 cfs on Kenai River near Cooper Landing (drainage area, 634 square miles) was only 53 percent of the November median, and 3d lowest for the month since records began in 1948. Monthly mean flows have been less than their respective medians for the past 7 months.

Ground-water levels in the Anchorage area declined slightly or were unchanged in water-table wells, and rose about 2 feet in the deep artesian aquifers.

HAWAII

Streamflow increased seasonally in all parts of the State and was above the normal range at the index stations on the islands of Kauai and Hawaii. Almost continuous rains during the month eased drought conditions on the island of Maui and water supplies there were considered to be normal at monthend. Monthly mean flow at the index station, Honopou Stream near Huelo, Maui, was above median for the first time in 8 months. Cumulative runoff at that station during the 7-month period, April through October 1973, was about 40 percent of median.

USABLE CONTENTS OF SELECTED RESERVOIRS NEAR END OF NOVEMBER 1973

[Contents are expressed in percent of reservoir capacity. The usable storage capacity of each reservoir is shown in the column headed "Normal maximum."]

Reservoir Principal uses: F–Flood control I–Irrigation M–Municipal P–Power R–Recreation W–Industrial	End of Oct. 1973	End of Nov. 1973	End of Nov. 1972	Average for end of Nov.	Normal maximum
	Percent of normal maximum				
NORTHEAST REGION					
NOVA SCOTIA					
Rossignol, Mulgrave, Falls Lake, St. Margaret's Bay, Black, and Ponhook Reservoirs (P)	48	41	52	36	223,400 (a)
QUEBEC					
Gouin (P)	94	93	66	71	10,865 ac-ft
Allard (P)	82	78	94	57	438 ac-ft
MAINE					
Seven reservoir systems (MP)	70	68	62	54	178,489 mcf
NEW HAMPSHIRE					
Lake Winnipesaukee (PR)	59	62	81	55	7,200 mcf
Lake Francis (FPR)	62	64	82	78	4,326 mcf
First Connecticut Lake (P)	65	69	86	77	3,330 mcf
VERMONT					
Somerset (P)	59	65	72	70	2,500 mcf
Harriman (P)	55	59	79	64	5,060 mcf
MASSACHUSETTS					
Cobble Mountain and Borden Brook (MP)	64	63	76	72	3,394 mcf
NEW YORK					
Great Sacandaga Lake (FPR)	48	45	72	55	34,270 mcf
Indian Lake (FMP)	66	72	85	57	4,500 mcf
New York City reservoir system (MW)	70	64	81	.....	547,500 mg
NEW JERSEY					
Wanaque (M)	61	53	89	65	27,730 mg
PENNSYLVANIA					
Wallenpaupack (P)	45	49	75	48	6,875 mcf
Pymatuning (FMR)	83	77	91	77	8,191 mcf
MARYLAND					
Baltimore municipal system (M)	93	91	100	81	85,340 mg
SOUTHEAST REGION					
NORTH CAROLINA					
Bridgewater (Lake James) (P)	75	72	77	75	12,580 mcf
High Rock Lake (P)	68	39	65	56	10,230 mcf
Narrows (Badin Lake) (P)	97	93	91	92	5,616 mcf
SOUTH CAROLINA					
Lake Murray (P)	82	83	78	55	70,300 mcf
Lakes Marion and Moultrie (P)	82	81	77	59	81,100 mcf
SOUTH CAROLINA--GEORGIA					
Clark Hill (FP)	70	65	52	47	75,360 mcf
GEORGIA					
Burton (PR)	72	61	72	53	104,000 ac-ft
Lake Sidney Lanier (FMPR)	58	53	41	45	1,686,000 ac-ft
Sinclair (MPR)	80	83	58	68	214,000 ac-ft
ALABAMA					
Lake Martin (P)	81	73	63	56	1,373,000 ac-ft
TENNESSEE VALLEY					
Clinch Projects: Norris and Melton Hill Lakes (FPR)	39	61	43	27	1,156,000 cfsd
Holston Projects: South Holston, Watauga, Boone, Fort Patrick Henry, and Cherokee Lakes (FPR)	52	57	54	30	1,452,000 cfsd
Douglas Lake (FPR)	24	26	23	14	703,100 cfsd
Hiwassee Projects: Chatuge, Nottely, Hiwassee, Apalachia, Blue Ridge, Ocoee 3, and Parksville Lakes (FPR)	57	50	50	39	512,200 cfsd
Little Tennessee Projects: Nantahala, Thorpe, Fontana, and Chilhowee Lakes (FPR)	62	55	58	38	745,200 cfsd
WESTERN GREAT LAKES REGION					
WISCONSIN					
Chippewa and Flambeau (PR)	91	87	94	74	15,900 mcf
Wisconsin River (21 reservoirs) (PR)	52	47	88	63	17,400 mcf
MINNESOTA					
Mississippi River headwater system (FMR)	41	37	29	27	1,640,000 ac-ft

Reservoir Principal uses: F–Flood control I–Irrigation M–Municipal P–Power R–Recreation W–Industrial	End of Oct. 1973	End of Nov. 1973	End of Nov. 1972	Average for end of Nov.	Normal maximum
	Percent of normal maximum				
MIDCONTINENT REGION					
NORTH DAKOTA					
Lake Sakakawea (Garrison) (FIPR)	94	92	95	.....	22,640,000 ac-ft
NEBRASKA					
Lake McConaughy (IP)	84	84	78	68	1,948,000 ac-ft
OKLAHOMA					
Keystone (FPR)	124	117	95	93	661,000 ac-ft
Lake O' The Cherokees (FPR)	112	120	102	78	1,492,000 ac-ft
Tenkiller Ferry (FPR)	118	157	106	94	628,200 ac-ft
Lake Altus (FIMR)	47	47	9	46	134,500 ac-ft
Eufaula (FPR)	102	147	106	81	2,378,000 ac-ft
OKLAHOMA--TEXAS					
Lake Texoma (FMPRW)	104	117	99	91	2,722,000 ac-ft
TEXAS					
Possum Kingdom (IMPRW)	89	89	95	79	724,500 ac-ft
Buchanan (IMPW)	81	82	79	77	955,200 ac-ft
Bridgeport (IMW)	52	53	57	41	386,400 ac-ft
Eagle Mountain (IMW)	99	100	91	86	190,300 ac-ft
Medina Lake (I)	100	100	96	47	254,000 ac-ft
Lake Travis (FIMPRW)	100	100	91	74	1,144,000 ac-ft
Lake Kemp (IMW)	59	60	42	76	319,600 ac-ft
THE WEST					
ALBERTA					
Spray (P)	84	75	75	67	210,000 ac-ft
Lake Minnewanka (P)	92	84	90	75	199,700 ac-ft
St. Mary (I)	48	48	69	59	320,800 ac-ft
WASHINGTON					
Franklin D. Roosevelt Lake (IP)	89	95	96	96	5,232,000 ac-ft
Lake Chelan (PR)	74	62	65	64	676,100 ac-ft
IDAHO--WYOMING					
Upper Snake River (7 reservoirs) (IMP)	48	58	73	57	4,282,000 ac-ft
WYOMING					
Pathfinder, Seminoe, Alcova, Kortes, Glendo, and Guernsey Reservoirs (I)	68	71	62	40	3,056,200 ac-ft
Buffalo Bill (IP)	52	53	80	72	421,300 ac-ft
Boysen (FIP)	97	94	80	78	802,000 ac-ft
Keyhole (F)	78	79	84	34	199,900 ac-ft
COLORADO					
John Martin (FIR)	0	1	1	14	364,400 ac-ft
Colorado–Big Thompson project (I)	82	82	72	54	722,600 ac-ft
Taylor Park (IR)	73	59	33	52	106,000 ac-ft
COLORADO RIVER STORAGE PROJECT					
Lake Powell; Flaming Gorge, Navajo, and Blue Mesa Reservoirs (IFPR)	93	71	57	.....	31,276,500 ac-ft
UTAH--IDAHO					
Bear Lake (IPR)	79	79	83	55	1,421,000 ac-ft
CALIFORNIA					
Hetch Hetchy (MP)	61	63	39	39	360,400 ac-ft
Lake Almanor (P)	84	90	72	43	1,036,000 ac-ft
Shasta Lake (FIPR)	74	83	75	64	4,377,000 ac-ft
Millerton Lake (FI)	32	43	47	38	503,200 ac-ft
Pine Flat (FI)	44	50	28	36	1,014,000 ac-ft
Isabella (FIR)	38	37	9	19	551,800 ac-ft
Folsom (FIP)	88	62	60	49	1,000,000 ac-ft
Lake Berryessa (FIMW)	86	93	73	74	1,600,000 ac-ft
Clair Engle Lake (Lewiston) (P)	78	91	75	72	2,438,000 ac-ft
CALIFORNIA--NEVADA					
Lake Tahoe (IPR)	61	68	59	46	744,600 ac-ft
NEVADA					
Rye Patch (I)	67	65	79	.....	157,200 ac-ft
ARIZONA--NEVADA					
Lake Mead and Lake Mohave (FIMP)	77	77	70	66	27,970,000 ac-ft
ARIZONA					
San Carlos (IP)	58	58	37	11	1,093,000 ac-ft
Salt and Verde River system (IMPR)	74	74	62	32	2,073,000 ac-ft
NEW MEXICO					
Conchas (FIR)	73	72	61	77	352,600 ac-ft
Elephant Butte and Caballo (FIPR)	28	28	13	25	2,539,000 ac-ft

[a] Thousands of kilowatt-hours

METRIC EQUIVALENTS OF UNITS USED IN THE WATER RESOURCES REVIEW

(Round-number conversions, to nearest four significant figures)

1 foot = 0.3048 meter 1 mile = 1.609 kilometers
1 acre = 0.4047 hectare = 4,047 square meters
1 square mile = 259 hectares = 2.59 square kilometers
1 acre-foot (ac-ft) = 1,233 cubic meters
1 million cubic feet (mcf) = 28,320 cubic meters

1 cubic foot per second (cfs) = 0.02832 cubic meters per second = 1.699 cubic meters per minute
1 second-foot-day (cfsd) = 2,447 cubic meters per day
1 million gallons (mg) = 3,785 cubic meters = 3.785 x 10^6 liters
1 million gallons per day (mgd) = 694.4 gallons per minute (gpm) = 2.629 cubic meters per minute = 3,785 cubic meters per day

Provisional data; subject to revision

FLOW OF LARGE RIVERS DURING NOVEMBER 1973

Station number	Stream and place of determination	Drainage area (square miles)	Mean annual discharge through September 1970 (cfs)	November 1973					
				Monthly discharge (cfs)	Percent of median monthly discharge[1]	Change in discharge from previous month (percent)	Discharge near end of month		
							(cfs)	(mgd)	Date
1–0140	St. John River below Fish River at Fort Kent, Maine.	5,690	9,397	2,820	40	+18	3,300	2,100	30
1–3185	Hudson River at Hadley, N.Y	1,664	2,791	1,750	88	.....	1,600	1,050	30
1–3575	Mohawk River at Cohoes, N.Y	3,456	5,450	3,470	88	.....	.....	.....	.....
1–4635	Delaware River at Trenton, N.J	6,780	11,360	5,777	64	+18	11,600	7,500	30
1–5705	Susquehanna River at Harrisburg, Pa.	24,100	33,670	25,230	120	+120	32,800	21,200	30
1–6465	Potomac River near Washington, D.C.	11,560	[2]10,640	7,650	184	+45	4,100	2,600	30
2–1055	Cape Fear River at William O. Huske Lock near Tarheel, N.C.	4,810	4,847	852	37	+14	870	560	30
2–1310	Pee Dee River at Peedee, S.C	8,830	9,098	4,620	103	-1	2,980	1,900	28
2–2260	Altamaha River at Doctortown, Ga.	13,600	13,380	3,923	84	-24	4,030	2,600	25
2–3205	Suwannee River at Branford, Fla	7,740	6,775	3,230	75	-27	3,050	2,000	24
2–3580	Apalachicola River at Chattahoochee, Fla.	17,200	21,690	12,400	112	+9	21,400	13,800	29
2–4670	Tombigbee River at Demopolis lock and dam near Coatopa, Ala.	15,400	21,700	8,490	147	+93	20,000	12,900	26
2–4895	Pearl River near Bogalusa, La	6,630	8,533	5,377	315	+74	11,600	7,500	30
3–0495	Allegheny River at Natrona, Pa	11,410	[2]18,700	18,300	170	+152	35,000	22,600	30
3–0850	Monongahela River at Braddock, Pa.	7,337	[2]11,950	14,700	227	+155	30,000	19,400	30
3–1930	Kanawha River at Kanawha Falls, W.Va.	8,367	12,370	10,750	163	+100	8,800	5,700	25
3–2345	Scioto River at Higby, Ohio	5,131	4,337	6,377	564	+255	29,500	19,100	28
3–2945	Ohio River at Louisville, Ky[3]	91,170	110,600	115,300	260	+234	298,500	192,900	28
3–3775	Wabash River at Mount Carmel, Ill.	28,600	26,310	13,780	183	+83	50,600	32,700	30
3–4690	French Broad River below Douglas Dam, Tenn.	4,543	[2]6,528	[2]4,665	133	+50	.....	.....	.....
4–0845	Fox River at Rapide Croche Dam, near Wrightstown, Wis.[3]	6,150	4,142	3,750	132	+44	.....	.....	.....
4–2643.31	St. Lawrence River at Cornwall, Ontario–near Massena, N.Y.[4]	299,000	239,100	293,500	129	-5	288,000	186,100	30
5–0825	Red River of the North at Grand Forks N. Dak.	30,100	2,439	2,156	199	-42	980	630	30
5–3300	Minnesota River near Jordan, Minn ..	16,200	3,306	2,310	277	+5	5,250	3,400	29
5–3310	Mississippi River at St. Paul, Minn ...	36,800	[2]10,230	13,200	234	-25	19,300	12,500	28
5–3655	Chippewa River at Chippewa Falls, Wis.	5,600	5,062	4,128	117	-25	.....	.....	.....
5–4070	Wisconsin River at Muscoda, Wis	10,300	8,457	6,841	115	+5	.....	.....	.....
5–4465	Rock River near Joslin, Ill	9,520	5,288	6,773	237	-18	8,140	5,300	30
5–4745	Mississippi River at Keokuk, Iowa ...	119,000	61,210	62,700	172	-25	81,500	52,700	30
5–4905	Des Moines River at Keosauqua, Iowa.	14,038	5,220	11,600	741	-42	15,800	10,200	30
6–2145	Yellowstone River at Billings, Mont.	11,795	6,754	4,205	117	-4	3,430	2,200	27
6–9345	Missouri River at Hermann, Mo	528,200	78,480	127,000	291	-42	168,000	109,000	26
7–2890	Mississippi River near Vicksburg, Miss.[5]	1,144,500	552,700	499,000	171	-8	680,000	439,000	30
9–3150	Green River at Green River, Utah ...	40,600	6,369	2,612	103	-30	3,850	2,500	30
9–4025	Colorado River near Grand Canyon, Ariz.	137,800	.....	7,377	.....	-9	.....	.....	.....
11–4255	Sacramento River at Verona, Calif ...	21,257	18,370	42,790	371	+204	60,200	38,900	28
13–2690	Snake River at Weiser, Idaho	69,200	17,670	16,200	114	+15	15,400	10,000	30
13–3170	Salmon River at White Bird, Idaho ..	13,550	11,060	7,812	152	+89	6,470	4,200	30
13–3425	Clearwater River at Spalding, Idaho ..	9,570	15,320	6,670	123	+61	6,370	4,100	30
14–1057	Columbia River at The Dalles, Oreg.[6]	237,000	194,000	119,100	112	+8	.....	.....	.....
14–1910	Willamette River at Salem, Oreg	7,280	23,370	68,310	246	+412	82,500	53,300	26–30
15–5155	Tanana River at Nenana, Alaska	27,500	24,040	6,910	86	-53	.....	.....	.....
8MF005	Fraser River at Hope, British Columbia.	78,300	95,300	58,200	118	-22	.....	.....	.....

[1] Reference period 1931–60 or 1941–70.

[2] Adjusted.

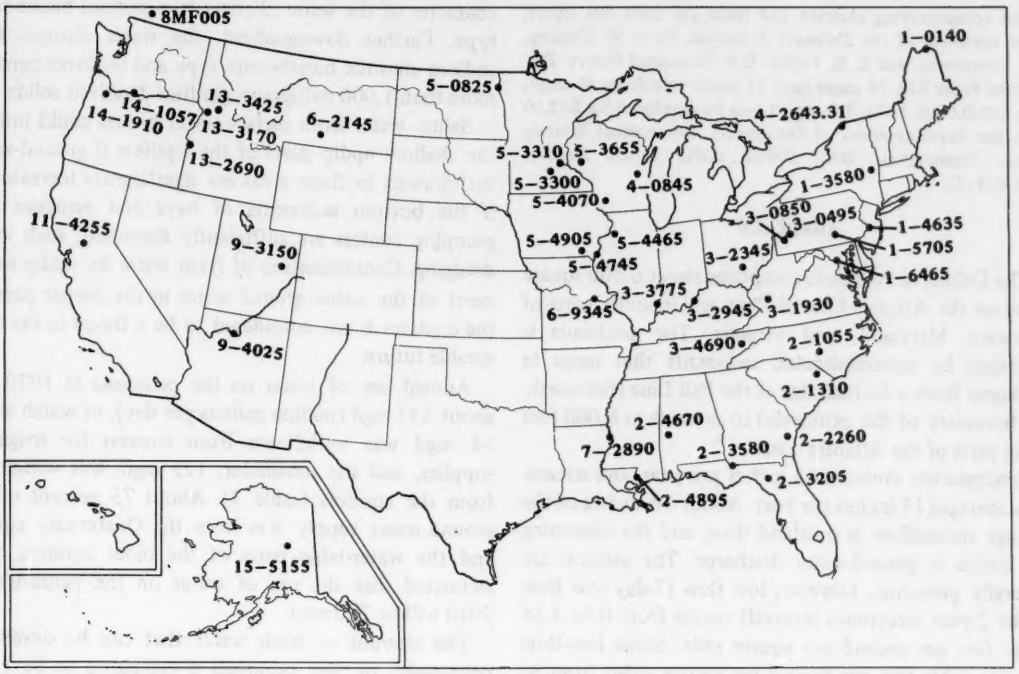
[3] Record furnished by Corps of Engineers.

[4] Record furnished by Buffalo district, Corps of Engineers, through International St. Lawrence River Board of Control. Discharges shown are considered to be the same as discharge at Ogdensburg, N.Y. when adjusted for storage in Lake St. Lawrence.

[5] Records of daily discharge computed jointly by Corps of Engineers and Geological Survey.

[6] Discharge determined from information furnished by Bureau of Reclamation, Corps of Engineers, and Geological Survey.

SELECTED STREAM-GAGING STATIONS ON LARGE RIVERS



Location of stream-gaging stations on large rivers listed in table on page 8.

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Cover map shows generalized pattern of streamflow for November based on 22 index stream-gaging stations in Canada and 130 index stations in the United States. Alaska and Hawaii inset maps show streamflow only at the index gaging stations which are located near the points shown by the arrows.

Streamflow for November 1973 is compared with flow for November in the 30-year reference period 1931–60 or 1941–70. Streamflow is considered to be *below the normal range* if it is within the range of the low flows that have occurred 25 percent of the time (below the lower quartile) during the reference period. Flow for November is considered to be *above the normal range* if it is within the range of the high flows that have occurred 25 percent of the time (above the upper quartile).

Flow higher than the lower quartile but lower than the upper quartile is described as being within the *normal range.* In the Water Resources Review the median is obtained by ranking the 30 flows of the reference period in their order of magnitude; the highest flow is number 1, the lowest flow is number 30, and the average of the 15th and 16th highest flows is the median.

The normal is an average (but not an arithmetic average) or middle value; half of the time you would expect the November flows to be below the median and half of the time to be above the median. Shorter reference periods are used for the Alaska index stations because of the limited records available.

Statements about *ground-water levels* refer to conditions near the end of November. Water level in each key observation well is compared with average level for the end of November determined from the entire past record for that well or from a 20-year reference period, 1951–70. *Changes in ground-water levels,* unless described otherwise, are from the end of October to the end of November.

The Water Resources Review is published monthly. Special-purpose and summary issues are also published. Issues of the Review are free on application to the Water Resources Review, U.S. Geological Survey, Reston, Virginia 22092.

This issue was prepared by J.C. Kammerer, H.D. Brice, I.G. Grossman, and L.C. Fleshmon from reports of the field offices, December 10, 1973.

The accompanying abstract and table are from the report, *Water resources of the Delmarva Peninsula*, by E. M. Cushing, I. H. Kantrowitz, and K. R. Taylor: U.S. Geological Survey Professional Paper 822, 58 pages (and 12 plates containing 46 maps, scale 1:500,000), 1973. The report may be purchased for $12.10 from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402 (GPO Stock Number 2401-02412).

ABSTRACT

The Delmarva Peninsula comprises about 6,500 square miles on the Atlantic Coastal Plain and includes parts of Delaware, Maryland, and Virginia. The peninsula is underlain by unconsolidated sediments that range in thickness from a featheredge at the Fall Line (the northern boundary of the peninsula) to as much as 8,000 feet along parts of the Atlantic coast.

Precipitation averages 43 inches per year, and streamflow averages 15 inches per year. About 6½ inches of the average streamflow is overland flow, and the remaining 8½ inches is ground-water discharge. The streams are generally perennial; however, low flow (7-day low flow at the 2-year recurrence interval) ranges from 0 to 1.16 cubic feet per second per square mile. Some low-flow data (in cubic feet per second per square mile) from 36 daily-record gaging stations, 25 partial-record gaging stations, and 120 miscellaneous sites are summarized for ready comparison.

Drafts that may be made from specified amounts of storage with a chance of deficiency once in 5, 10, and 20 years, on a long-term average, are related to the median annual 7-day (7-day 2-year) low flow to permit preliminary estimates to be made of storage requirements to supplement natural low flows.

Streamflow is generally low in dissolved solids and chemically suitable for most uses except in the downstream reaches of those streams subject to tidal invasion of saline water.

Ten regional aquifers furnish nearly all the water used on the peninsula. Hydraulic characteristics vary from aquifer to aquifer and from place to place within each aquifer. The Quaternary aquifer, which is the most areally extensive, generally has the highest transmissivity and is the most productive water-bearing unit on the peninsula. It is also the most susceptible to pollution. Large parts of all the aquifers contain water of generally good chemical quality. In the recharge areas of the various aquifers, ground water is a calcium bicarbonate type, generally with less than 250 milligrams per liter dissolved solids. As water moves downgradient in the aquifers, the dissolved-solids content increases and the chemical character of the water changes to a sodium bicarbonate type. Farther downgradient, the water changes to a sodium chloride bicarbonate type and in places contains more than 1,000 milligrams per liter dissolved solids.

Saline water from surface-water bodies could intrude the shallow updip parts of the aquifers if ground-water withdrawals in these areas are significantly increased or if the bottom sediments of bays and estuaries near pumping centers are sufficiently disturbed, such as by dredging. Contamination of fresh water by updip movement of the saline ground water in the deeper parts of the aquifers is not considered to be a threat in the foreseeable future.

Annual use of water on the peninsula in 1970 was about 137 mgd (million gallons per day), of which about 14 mgd was withdrawn from streams for irrigation supplies, and the remainder, 123 mgd, was withdrawn from the aquifers (table 1). About 75 percent of the ground-water supply was from the Quaternary aquifer and the water-table parts of the older aquifers. It is estimated that the use of water on the peninsula by 2010 will be 260 mgd.

The amount of fresh water that can be developed perennially on the peninsula is estimated to be 1,500 mgd. This amount is about 10 times the 1970 use and about six times the estimated use by the year 2010. Large long-term water supplies will probably have to be developed from the Quaternary aquifer. The perennial yield of this aquifer is estimated to be 1,000 mgd.

Table 1.—*Population and water-use data for the Delmarva Peninsula for 1950 and 1970*

	1950	1970	Annual rate of change, 1950 to 1970 (percent)
Population	418,399	566,690	+1.6
Ground-water use (mgd):			
Public supply	21	45	+4.0
Domestic supply	11	24	+4.1
Industrial supply	26	46	+3.0
Livestock supply	6	5	−0.8
Irrigation supply	0	3	
Total	64	123	+3.4
Surface-water use (mgd):			
Irrigation supply	8	14	+2.9
Total	8	14	+2.9
Total water use	72	137	+3.3

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